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DEVELOPMENT OBJECTIVES
TWIN-STAGE, ON-LINE PI COMPARATOR
#02228

1. INTRODUCTION

These development objectives describe the requirements to be met in the design and fabrication of an operational prototype Twin-Stage Comparator.

2. CONCEPT

This project is to develop an instrument to provide the photo interpreter with a capability for obtaining precise measurements as part of routine photo interpretation.

The Twin-Stage Comparator is intended to bridge the gap between the high-precision mensuration tools currently available to the photogrammetrist and the cruder instruments normally used by the photo interpreter. In designing this instrument, emphasis is to be placed on ease of operation reliability, simplicity, measuring accuracy, and manufacturing production quantities of 10 or more at a reasonable price.

3. GENERAL DESCRIPTION

This shall be a compact light weight device incorporating a high performance stereo viewing system, twin scanning stages, and a measuring engine with two-axis digitizers. The Government is presently using a stereo viewing system that meets the requirements of this project. The viewing system is covered in Par. 4.1.

The two photo stages shall be supported on separate X-Y carriages and have a free aperture of 6 by 6 inches. A differential drive shall be provided between the two photo stages to permit stereo scanning of film chips of two different scales.

The movements of the X-Y carriages of one photo stage shall be measured by two digitizers (X-Y) with a measuring range of 6 inches in both the X and Y directions. The signals from the X-Y digitizers shall be processed and converted into a format acceptable for on-line computer use.

4. DETAILED REQUIREMENTS

4.1 Viewing System

The Government has in use a redesign of the [redacted] High Power Stereo- viewer. This viewer has a reticle located in an intermediate image plane of one of the optical paths and it is being successfully employed as part of an ultra precise mensuration system. STAT

The Technical specifications for this Stereoviewer are attached to this Development Objective.

The focusing mechanism is not provided as part of the viewing system. The contractor will have to design the instrument focusing system. This may be accomplished by moving the individual film stages in the Z direction (up and down) or by raising and lowering the optical system. Both a coarse and a fine instrument focus shall be provided; the gear ratios of these focus motions must be appropriate to the magnification ranges involved. A fine focus mechanism shall be provided to accomplish differential focusing between the two stages.

The contractor is encouraged to use this optical viewing system as part of the comparator. If he prefers a substitute system, two alternate bids shall be submitted, one based on the [redacted] system and the other on the substitute system. STAT

4.2 Film Stage and Hold-down System

4.2.1 There shall be two film stages, each capable of handling film chips in sizes up to 6 inches by 6 inches.

4.2.2 Each of the film stages shall be supported on separate X-Y carriage assemblies.

4.2.3 Each of the film stages shall have independent translation of ± 3 inches in both the X and Y axis. Appropriate warning signals and cutoff circuitry shall be provided to prevent damage to the film stages when they are on a collision course. The optical viewing systems and the illumination source shall remain stationary (in X and Y).

4.2.4 The measuring stage shall provide a mechanical rotation of at least ± 10° and the non-measuring stage shall have 360° rotation capability.

4.2.5 A design goal shall be a variable differential drive between the two film stages to permit the scanning of two images of different scale in stereo. The X and Y motions of both stages shall be remotely controlled from the operator's console.

Provision must be made for both independent and common stage-drive speeds varying from .0002 inch per second to 1 inch per second.

4.2.6 Film hold-down may be accomplished through glass pressure plates or other mechanical means, but it must be capable of maintaining the film flat and in sharp focus over the entire format.

4.3 Film Measurement System

4.3.1 Only one of the two film stages shall have a measuring capability. This measuring stage shall have two-axis (X and Y) digitizers with a measuring range of ± 3 inches in both axes.

4.3.2 The prime objective of this system is to produce the highest possible accuracy over short distances (up to 1 inch) with less emphasis on accuracy over longer distances. A design goal shall be 2-micron accuracy for measurements of 1 inch or under. An accuracy of at least 1 part in 5,000 shall be provided over the entire film format.

4.3.3 Repeatability of measurements is of major importance in this development.

4.3.4 The least count or pulse increment shall be 1 micron.

4.3.5 The deviation from orthogonality of the X and Y axis of the measurement system shall be less than 5 seconds of arc.

4.4 Measurement Readout System

The Twin Stage Comparator is intended for on-line computer use at the customer's facility utilizing a UNIVAC 494 as the central computer.

4.4.1 Since most of the customers in-house on-line systems utilize [redacted] components, the vendor is requested to use compatible (not necessarily [redacted] equipment. Attachment 4 provides the specifications for the data acquisition system.

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4.4.2 The Contractor will provide and fabricate; (1) a control panel [redacted] 2825A or equivalent) with integral visual display; (2) movable cabinet (on casters) containing the necessary electronic decoders, synchronizers, buffers, special character generators, etc. to process and convert the data from the two-axis encoders and from the control panel into a signal which will be accepted by the central computer utilizing existing programs.

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4.5 Stage Illumination

4.5.1 General. A high-intensity optimized condenser type light source shall be provided beneath the surface glass plate of each chip stage. This source shall be designed for and mated with the microscope to insure maximum total performance from the optical viewing system.

4.5.2 Intensity Range. At full intensity, the high-intensity sources must provide adequate illumination of a film area with an average density of 2.5 units as viewed through the optical system at both eye stations while operating at a magnification of 200X. All other magnification settings shall be equally well illuminated. These sources shall operate at a color temperature between 2800° - 5500°K.

4.5.3 Variability of Intensity. Means shall be provided for continuously varying the illumination from 50% to 100% of full intensity on each independent high-intensity source without reducing the color temperature below 2800°K.

4.5.4 Control of Intensity. Separate controls for varying the intensity of illumination of each separate illumination source shall be provided.

4.5.5 Heat. The temperature on the surface of each stage plate shall not exceed 100°F after operating at maximum intensity over a 24-hour period in an 80°F ambient temperature while a neutral density of 1.5 covers the plate. Necessary care shall be taken to assure that the film is adequately cooled so as to prevent dimensional changes which could affect mensuration reliability.

4.5.6 Overall Illumination. A second, overall lighting system shall be provided to illuminate the entire format for general viewing and pre-selection of points to be measured.

4.6 Control Console

4.6.1 General. The complete system shall be designed in accordance with correct ergonomic principles for easy, comfortable, rapid operation.

4.6.2 Controls shall be provided for setting a 5 to 1 (or larger) variable differential drive to couple the corresponding axes of the second (non-measuring) stage to those of the measuring stage.

4.6.3 Controls shall permit independent translation of either stage or common translation of both stages with a single "joystick."

4.6.4 The stage drive controls for both slewing and fine positioning shall be smooth and positive.

4.6.5 Continously variable speed drive controls to cover the range of .0002 inch per second to 1 inch per second to 1 inch per second must be provided.

4.6.6 See Attachment 4 for numerical display and input panel.

4.7 Overall Physical Considerations

4.7.1 The size of this comparator is to be kept at a very minimum. The length and width shall be no greater than 48 inches by 34 inches.

4.7.2 The comparator shall have its own stand or mounting and shall be provided with suitable casters for moving. Leveling pads or mounts, that can be easily and quickly activated, shall be provided.

4.7.3 This instrument shall be designed to operate in a normal PI work area. The environmental conditions in this work area will normally be held to temperatures of 72°F ± 5° and relative humidities of 55% (+ 15% to - 5%).

4.7.4 Shielding shall be provided throughout the system so that no circuits are adversely affected by RFI.

4.8 Reliability and Service Time

4.8.1 The comparator and related equipment shall be designed to withstand service usage, under normal operating conditions, for a period of 500 hours (5 hours per day operation) without significant degradation of performance, and with only minor maintenance due to normal expendable replacement parts.

4.8.2 Reliability and maintainability shall be a major factor in the planning, design, and engineering of this instrument.

4.8.3 The design shall permit: 1) ease of assembly and disassembly, 2) ready access to potential trouble sources, 3) maintenance with tools and equipment normally available to maintenance personnel, and 4) external test points.

5. MISCELLANEOUS

5.1 Although there are certain very high performance requirements for this instrument, it should be emphasized that many areas of potential automation are omitted so that the requirements may be satisfied with a minimum of complexity, size, and cost. If there are devices or subsystems which are not specifically listed as requirements, but which might significantly contribute to the usefulness or ease of operation, they may be included at the vendor's discretion as optional features in the proposal. However, each optional feature must be individually priced.

5.2 At the time of delivery of the equipment, the contractor shall also provide the following: 1) Operators Instruction Manual; 2) Maintenance Manual (including schematics); 3) Recommended spare parts list, including the cost of each item and the total parts package cost. (See attached copy of DB-1003, dated 31 August 1966).

5.3 Electric Hazard. The unit must be grounded and free of all electric shock hazards.

5.4 Warning Light. A warning light must be provided to show when the power supply to the system is switched on.

5.5 Controls. All controls must be properly marked, conveniently located, and readily accessible to the operator.

5.6 Alarms. Limit switches shall be located at the extremes of travel of the X and Y carriages of both film stages to prevent damage to the system.

5.7 Reporting. The contractor shall agree to comply with reporting procedures as stated in specification Np. DB-1001, dated 31 August 1966. (Copy attached.)

5.8 Interface. The contractor shall be responsible for all electronic interfacing, logic circuitry, and cabling between the digitizers, encoders, digital display, and on-line computer.

6. CONTRACTOR'S PROPOSAL

6.1 The contractor's proposal must include answers to the following questions:

6.1.1 Is it theoretically feasible to develop the comparator as described in these Development Objectives?

6.1.2 Is it practical to fabricate such an instrument? This analysis must include an economic analysis of the various features required, an examination of the practical compromises, and a comparison of the cost of the advanced features (both prototype and production models) as related to the value of increasing the various levels of instrument performance above that of existing equipment. Alternates and their relative costs shall be included.

6.1.3 What problems are anticipated in the manufacture of the instrument? This analysis must include the anticipated cost of various production quantities (up to 20), as well as an estimate of the prototype development and fabrication cost.

6.2 Artist Concept. An artist concept of the system shall be included in the proposal. It shall be no larger than 8 1/2 by 11 inches.

6.3 Production Cost. The proposal shall include an estimate of production costs of the instrument in quantities of 5, 10, 15, and 20. Desirable options may be included if the contractor wishes; however, they must be priced both jointly and separately.

Attachments:

1. Specification No. DB-1001, dated 31 August 1966
2. Specification No. DB-1003, dated 31 August 1966
3. Tech Specs on [redacted] Stereoviewer
4. Tech Specs for Optics if [redacted] Stereoviewer is not used.
5. Data Format

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